RESEARCH HIGHLIGHT

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HOUSEHOLD ENVIRONMENTAL MONITORING—A STRATEGY TO HELP HOMEOWNERS REDUCE THEIR ENVIRONMENTAL IMPACT

INTRODUCTION

Through federal initiatives such as the One-Tonne Challenge[1], Canadians are being asked to reduce their personal environmental impact and greenhouse gas (ghg) emissions to help our country meet its Kyoto commitment. In surveys over the last decade, 90 per cent of Canadians have indicated they feel a great deal or fair amount of concern about the state of the environment. Yet, over the same period, the percentage who believe they have a personal responsibility for protecting the environment or that they can do something to help the environment has dropped. The objective of this research was to test the hypothesis that we can motivate environmentally sustainable behaviour at the household level by providing homeowners with a clear picture of their environmental impact, tangible reasons for improvement, and tailored solutions to follow.

To test this hypothesis, a study group of 20 households was established in an 85-year old community about three kilometres east of the downtown centre of Ottawa, Ontario. Each household completed surveys about environmental attitudes and household practices. They also participated in a one-week monitoring exercise that tracked home heating, electricity and water consumption, vehicle usage and waste generation. The research team gathered physical information on each household, previous year utility bills, and arranged for an EnerGuide Home Energy assessment[2]. This information was assembled into a personalized report for each household describing their environmental impact in comparison with other households in the study group, and recommending the measures that would most cost-effectively reduce that repercussion. A community forum of the study group was held to discuss results, the value of the process and potential environmental initiatives. One year after the initial monitoring period, participants provided information on the measures they had implemented as a result of the study, their mileage readings, and utility bills for the last 12 months.

RESULTS

Study results indicated that the monitoring technique was valuable in two ways. The technique resulted in concrete reductions in environmental impact among the study group. In addition, the compilation of detailed data for 20 neighbouring households provided insights into factors affecting environmental impact and the types of initiatives that have the most potential to reduce it. The following results were observed among the study group.

[1] The One-Tonne Challenge is a Government of Canada initiative launched in 2005 that suggests greenhouse gas reduction strategies and encourages each Canadian to reduce their greenhouse gas emissions by one tonne.

[2] The Energuide for Houses program is a federal initiative which rates existing home energy efficiency and provides grants based on measured improvements to this rating.

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- Participants commented that they became much more aware of their energy consumption and environmental impact by taking part in the study and were, as a result, motivated to make changes to their behaviour and physical surroundings. Across the 20 participating households, 26 per cent of the recommended environmental measures were implemented in the first year, resulting in an estimated average greenhouse gas reduction of about 12 per cent, or two tonnes per household, as detailed in Figure 1.

- A survey of participants indicated that their top priorities in making decisions about home upgrades were improving comfort and lowering operating costs, with reducing environmental impact and improving air quality ranked as lower priorities. The major obstacles to reducing environmental impact were seen as financial cost and lack of time and knowledge to evaluate and implement environmental measures. In keeping with this emphasis on practical, cost-effective elements, most of the environmental measures that were implemented by participants were those that the household report identified to participants as high priority, with a less than 10-year payback period.

House No.	No. of Occupants	GHG per Household (T)					
		Existing GHG	Recommended Reductions	Implemented Reductions	Revised GHG	% of Recommended Implemenations	% Total Reductions in GHG
1	4	12.20	5.68	0.99	11.21	17%	8%
2	2	11.70	3.80	0.00	11.70	0%	0%
3	3	19.50	10.75	0.00	19.50	0%	0%
4	4	29.90	12.10	1.72	28.18	14%	6%
5	4	15.90	7.06	1.47	14.43	21%	9%
6	n/a	Note 1	n/a	n/a	n/a	n/a	n/a
7	2	13.70	9.77	2.35	11.35	24%	17%
8	4	27.50	21.01	15.36	12.14	73%	56%
9	4	13.90	5.88	0.95	12.95	16%	7%
10	3	9.10	2.38	0.42	8.68	18%	5%
11	5	13.50	4.18	1.57	11.93	38%	12%
12	4	14.90	4.43	0.63	14.27	14%	4%
13	3	13.90	4.60	0.84	13.06	18%	6%
14	1	16.70	12.10	3.12	13.58	26%	19%
15	4	9.80	3.00	1.18	8.62	39%	12%
16	4	14.00	3.49	0.37	13.63	11%	3%
17	2	7.60	3.72	2.38	5.22	64%	31%
18	4	10.90	2.40	0.75	10.15	31%	7%
19	n/a	Note 2	n/a	n/a	n/a	n/a	n/a
20	2	19.30	7.98	3.40	15.90	43%	18%
Avgs	**3.22**	**15.22**	**6.91**	**2.08**	**13.14**	**26%**	**12%**

Notes: 1. One year follow-up information was not available because owners had moved from their home.
2. One year follow-up information was not provided by participant household.

Figure 1: GHG Reductions Resulting from Household Report Recommendations

- Of the approximately 30 recommended environmental measures, 13 were implemented by 20 per cent or more of the households. These included the electricity saving measures of replacing incandescent bulbs with compact fluorescent ones, activating energy saving settings on computers, installing ceiling fans, and reducing air conditioning use. The most popular heating energy reduction measures included increasing air tightness of the building envelope, and insulating foundation walls, above-grade walls and hot water tanks. Vehicle emissions reductions through lower vehicle use and ethanol blended gasoline were implemented by one third of households. The most frequently adopted water savings measures included replacing toilets with water saving models, installing kitchen faucet aerators, reducing sprinkler use and installing rain barrels. All households were already recycling and 90 per cent were composting at the beginning of the study.
- Including a number of households within the same community and providing comparisons between these households proved useful in motivating participants and helping to put their environmental impact in perspective. Very large differences in consumption rates and greenhouse gas emissions were recorded between quite similarly situated households, illustrating how much effect lifestyle decisions, conservation practices, and energy-conscious home improvements can have. Households with both higher-than-average and lower-than-average environmental impact were motivated to make further efforts to reduce it even more.
- The observed differences between household environmental impact were substantial, as indicated in Figure 2. Home heating fuel, electricity and water consumption per occupant was 5.5 to 7.5 times greater in the highest-consuming household compared to the lowest, with average consumption about 2.5 times the lowest recorded level. Vehicle emissions and waste production were even more variable, with highest levels at 11 to 21 times the lowest levels, and average levels at about six times the lowest ones. The total greenhouse gas emissions per occupant was 5.5 times greater in the household with the highest environmental impact compared to the lowest one. These variations indicated that—for at least this population group—it is not accurate to assume individual Canadians are producing greenhouse gases at roughly similar rates, or realistic to ask them to cut emissions by the same amount.
- While the average greenhouse gas emissions recorded among the study group at the beginning of the study was very close to the One-Tonne Challenge estimate of over five tonnes per Canadian, the percentage of this total derived from automobile use, home heating and electricity differed from Canadian averages. Instead of average rates of 50 per cent emissions from transportation, 40 per cent from home heating and 10 per cent from electricity use, the study group breakdown was 30 per cent transportation, 50 per cent home heating and 20 per cent electricity. This is reasonable for a community of older homes where low levels of insulation and air tightness result in increased heating costs, and where convenient access to downtown, shops and public transportation encourages lower-than-average automobile use. These results suggest that the kinds of environmental initiatives that will make the most difference could vary significantly among communities.

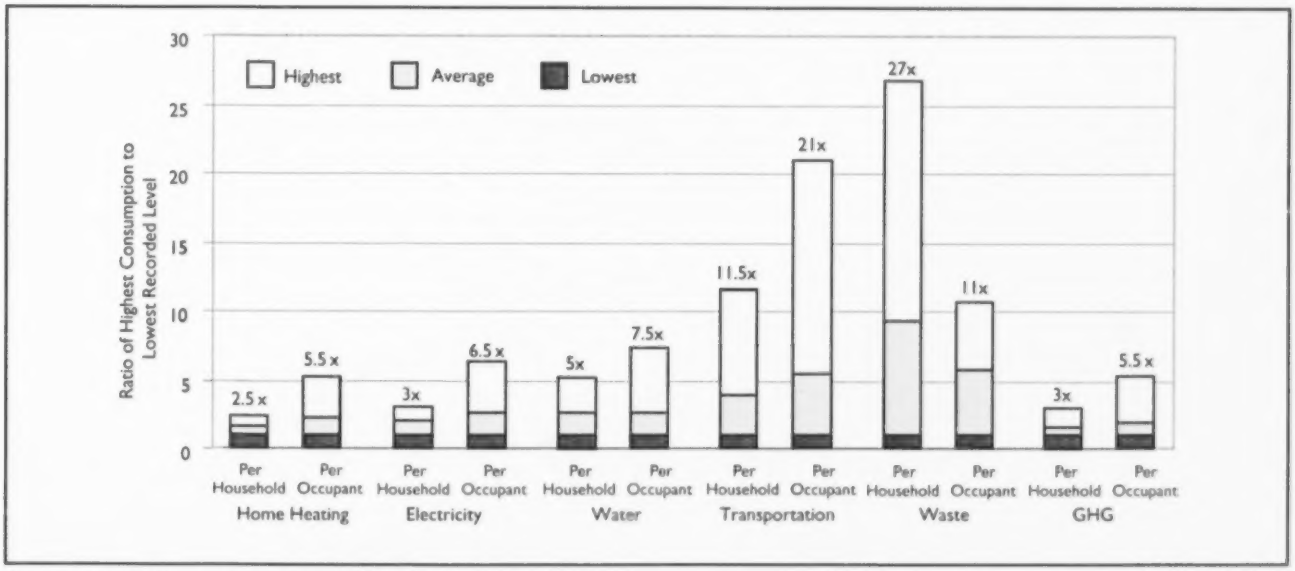

Figure 2: Variability of Household Results at Beginning of Study

- As Figure 3 indicates, existing greenhouse gas emissions per household vary dramatically as do the recommended and implemented household reductions. One four-person household (labelled "A" in Figure 3) stands out for the magnitude of its ghg reduction of over 15 tonnes or 3.8 tonnes per person, resulting from implementation of 12 of the 16 recommended measures. In this case, the most significant reductions related to changes in automobile use, including replacement of two vehicles with one more efficient vehicle, reducing the amount driven by 25 per cent, and switching to ethanol gasoline. Other measures included adding insulation, increasing air tightness, installing low-flow fixtures, rain barrels, ceiling fans and reducing air conditioning usage. Household "B" is noteworthy because it began the study with the lowest household greenhouse gas emissions in the group at 7.5 tonnes or 3.8 tonnes per occupant, yet was still able to reduce this amount by a further 30 per cent or 1.2 tonnes per occupant.
- There were several common factors among the households with the highest environmental impact per occupant. The floor area per occupant was generally higher than average, most owned two vehicles, at least one of which was a large fuel-inefficient vehicle, they drove more than the average, and they tended to be homes with one or two occupants over 40 years of age, with no children living in the household. These lifestyle factors appeared to have more impact than the environmental features we think of most often like the quality of the building envelope or energy efficiency of appliances and fixtures. Strategies to encourage wise use of space, house downsizing as families age, and reduced vehicle size and use are an important part of efforts to reduce environmental impact. A few households with very high consumption had a disproportionate effect in raising the average environmental impact of the study group.
- At the beginning of the study, 11 of the 20 households were already producing less than the One-Tonne Challenge goal of four tonnes of greenhouse gas emissions per person. Four households were operating at less than three tonnes per person. These homes tended to be modestly sized for the number of occupants; they had been carefully renovated to increase insulation values, air tightness, and energy efficiency of appliances and fixtures; car use was low and/or they owned very efficient vehicles; and the owners were consciously adopting conservation practices. Although these four households were already performing well compared to typical levels, in each case the owners elected to implement 30 to 40 per cent of the recommended measures to bring their greenhouse gas emissions down to between 2 and 2.5 tonnes per person. For many Canadian households it appears feasible to achieve targets well below the One-Tonne Challenge goal.
- While participants evaluated this environmental monitoring technique as more useful to them than existing government-sponsored projects such as the One-Tonne Challenge, a majority of participants stated that the most effective way for the government to reduce environmental impact would be to legislate higher mandatory environmental standards for house construction, car fuel efficiency, appliances, equipment, packaging etc. rather than relying on voluntary programs of any kind.

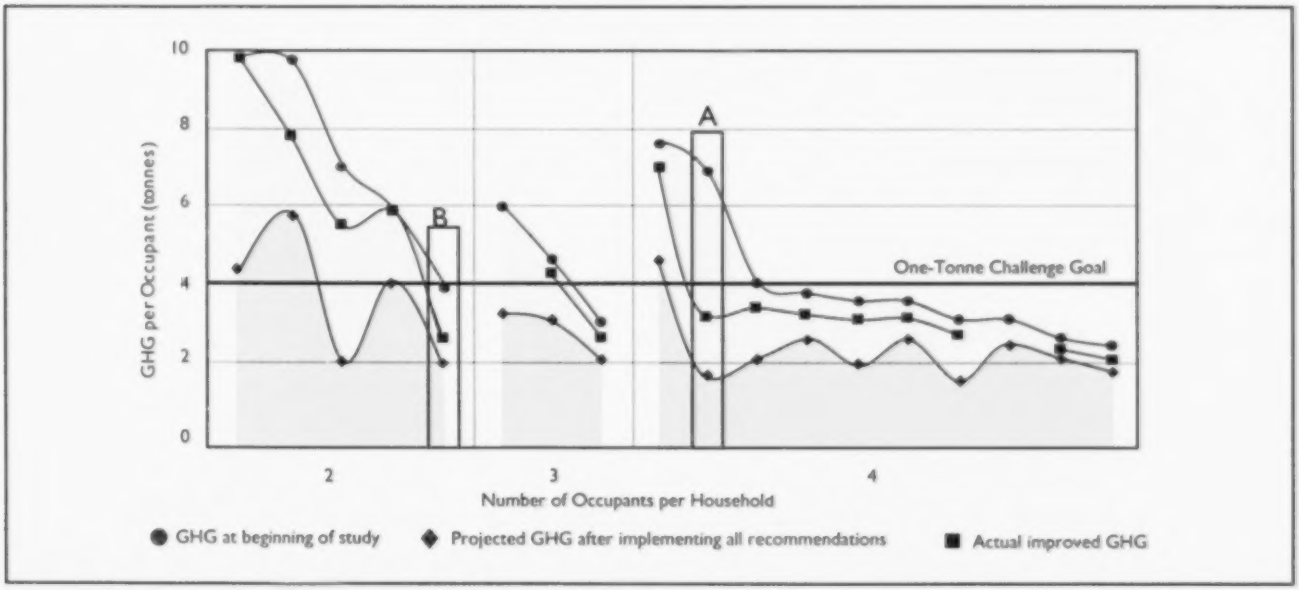

Figure 3: Existing, Potential and Improved Greenhouse Gas Emission Reductions per Occupant

CONCLUSION

The Household Environmental Monitoring Project demonstrated that homeowners are willing to take steps to lessen their environmental repercussions when provided with specific information about their existing impact and practical recommendations to reduce it. Participants indicated that they were motivated by learning how investments in environmental measures could improve home comfort and reduce operating costs, and by evaluating their own efforts within a neighbourhood context. However, they felt that regulations, grants and taxes to promote good environmental practices and products would be more effective at changing behaviour on a large scale than voluntary programs.

There were wide variations in consumption of home heating fuel, electricity, water and vehicle fuel between similarly situated households within a community. This illustrates that most families can reduce their individual environmental impact through lifestyle decisions, conservation practices and energy-conscious home improvements.

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